Nov. 29, 1966 F. A. GUERTH 3,289,190

MAGNETIC READOUT AND DISPLAY SYSTEM

Original Filed Oct. 14, 1958 3 Sheets-Sheet 1

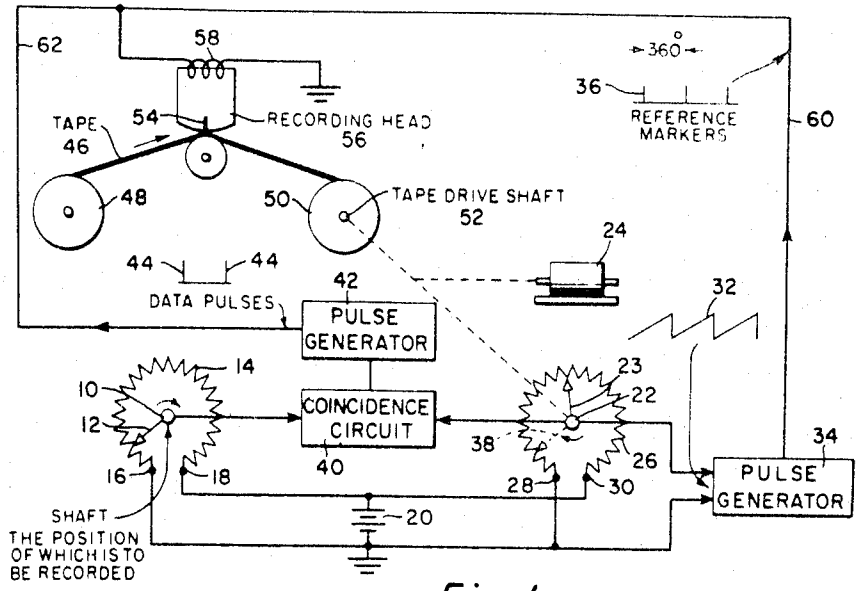


Fig. 1

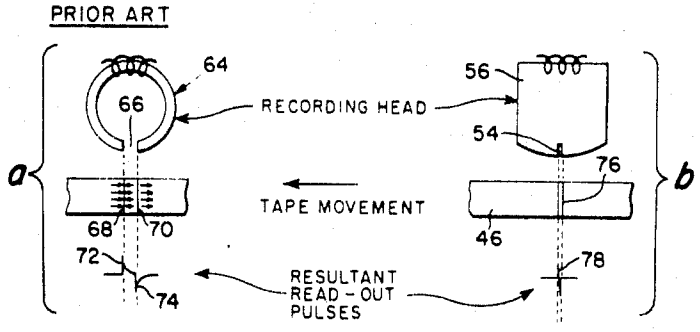


Fig. 2

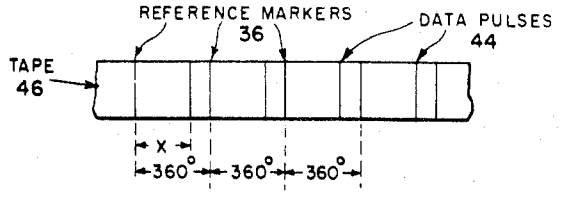


Fig. 3

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MAGNETIC READOUT AND DISPLAY SYSTEM

Original Filed Oct. 14, 1958 3 Sheets-Sheet 2

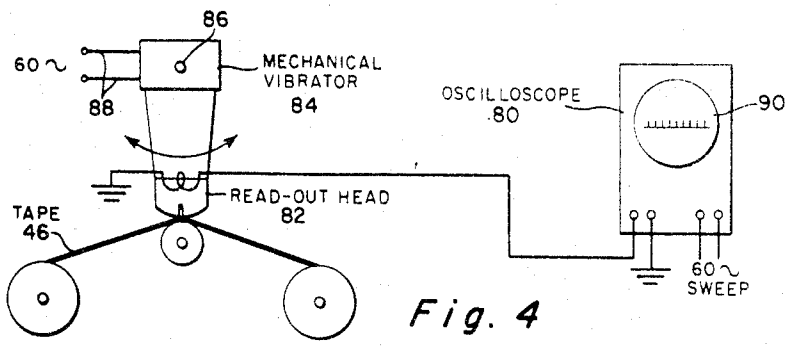


Fig. 4

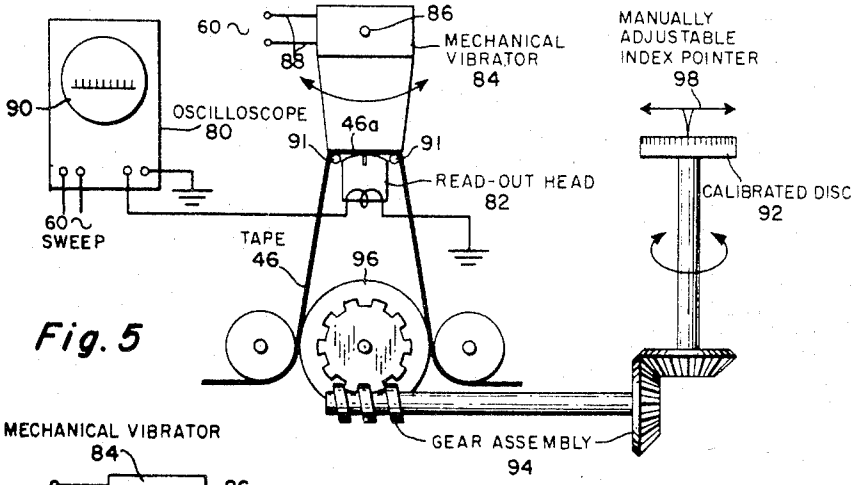


Fig. 5

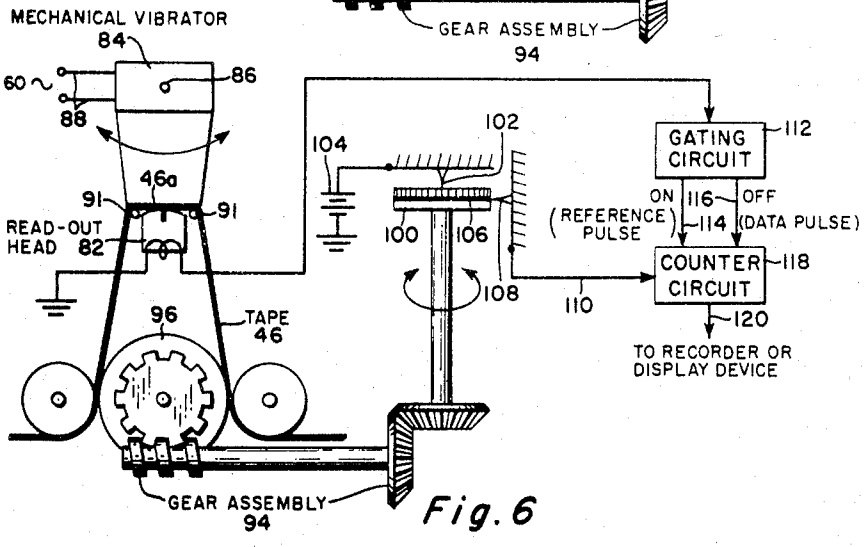


Fig. 6

MAGNETIC READOUT AND DISPLAY SYSTEM

Original Filed Oct. 14, 1958

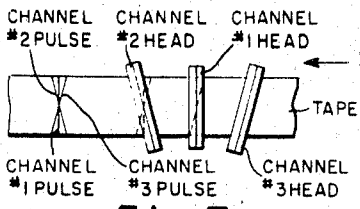


Fig. 7

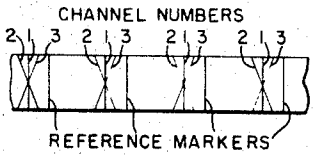


Fig. 8

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3,289,190

MAGNETIC READOUT AND DISPLAY SYSTEM

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Application May 8, 1962, Ser. No. 193,343, now Patent No. 3,258,755, which is a division of application Ser. No. 767,239, Oct. 14, 1958. Divided and this application Aug. 26, 1965, Ser. No. 489,458
1 Claim. (Cl. 340—174.1)

The invention described herein may be manufactured and used by or for the Government of the United States of America for Governmental purposes without the payment of any royalties thereon or therefor.

The present application is a division of my application entitled "Data Reproducing System," Serial No. 193,343, filed May 8, 1962, now U. S. Patent No. 3,258,755, which in turn is a division of application Serial No. 767,239, filed October 14, 1958, now abandoned.

The present invention relates in general to the reproduction of recorded intelligence. In one of its aspects, the invention is directed to the reproduction from a moving tape of a series of regularly-recurring reference pulses or markers of extremely short duration, together with a series of data pulses of similar form, each data pulse being spaced on a time scale from its associated reference pulse in accordance with a characteristic of the intelligence at the instance the particular data pulse is recorded.

So-called pulse-position-modulation (PPM) systems have been widely used for the transmission of signals within a limited band of frequencies. In such systems, variations in the values of successive samples of a modulating wave are represented by a shift in the position of a pulse along a time axis, so that the position of any particular pulse is indicative of the value of the modulating signal at the time of occurrence of that pulse. Since a PPM system of this nature is a constant-amplitude method of transmission, any interference present may be largely removed by limiting and/or clipping, resulting in an excellent over-all signal-to-noise ratio, as well as very satisfactory reproduction characteristics.

The art of recovering data on sensitized tape by means of a varying magnetic field has received much attention in recent years, resulting not only in a wider reproducible frequency range but also in more efficient utilization of the available tape surface. The number of different channels which may be recorded simultaneously has also been increased by dividing the sensitized tape into narrow bands extending in its direction of movement, with each such band representing a separate item of information such, for example, as one condition of the operation or environment of a guided missile or satellite.

However, three features of such a recording system act to limit the extent of its use. First, the number of channels is obviously restricted by the width of the tape, with at least a minimum separation distance between bands being necessary to avoid inter-channel cross talk. Secondly, when information of analog form is being recorded, the tape cannot pass by the recording head below a minimum speed without introducing objectionable distortion into the reproduced intelligence. This reduces the overall recording time, or, conversely, increases the length of tape used during a given period. Thirdly, even slight variations in tape speed during recording and/or reproduction cannot be tolerated, necessitating extremely precise operation of the tape driving mechanism.

The present invention overcomes all of the above disadvantages. In accordance with a feature thereof, data to be recorded is represented by pulses of very short time duration, each of these pulses being spaced (as in PPM systems) from a regularly-recurring indexing pulse or marker by a distance which is representative of the intelligence to be reproduced. By correlating the recording operation with the rate of tape movement, the spacing between successive marker pulses becomes independent of tape speed variations, and, since the data pulses are preferably obtained by a periodic sampling of the original intelligence at a predetermined frequency relationship, there is no restriction placed on minimum tape speed except that necessary to preclude actual overlapping or superimposition of successive pulses in a given channel. The invention in a further embodiment embraces the use of the entire width of the tape to record pulses representative of data in each channel, this being achieved by establishing a particular angular relationship of the respective pulses in each channel with respect to the longitudinal axis of the tape, such angular relationship being different for each channel and remaining constant throughout both the recording and reproducing operations.

One object of the present invention, therefore, is to provide an improved form of data recording and reproducing system.

Another object of the invention is to provide a system in which pulse energy is applied to a slowly moving tape by means of a recording head having a gap of extremely narrow dimensions, such that the electromagnetic impression formed by each pulse on the tape is, in effect, a pictorial representation of the gap itself.

A further object of the invention is to provide a system of magnetic tape recording in which data is represented by variations in pulse position with respect to a regularly-recurring indexing pulse or marker, and in which a plurality of channels of information may be recorded within the same general tape area through an angular variation in the relationship of the pulses respectively associated with such channels.

A still further object of the invention is to increase the number of channels of information that may be recorded on a given area of sensitized tape or other storage medium.

An additional object of the invention is to facilitate the reading out of information that has been electromagnetically recorded on a tape by producing a cyclically varying displacement, or oscillation, of the tape relative to the readout head, this relative movement acting in effect to scan a selected tape area and thus permit a prolonged inspection thereof.

A still further object of the invention is to provide for an automatic evaluation of recorded data through means which determines the spatial relationship between the reference materials and the data pulses and presents such information in a form that may be readily utilized by an observer.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

FIG. 1 is a partially schematic illustration of one system for recording data of the type with which the present invention may be utilized;

FIGS. 2(*a*) and (*b*) depict the relationships between recording gap width, tape impression or pattern, and readout pulses, and are drawn to provide a comparison between the operation of recording arrangements of the prior art and the recording system of FIG. 1, respectively;

FIG. 3 is a section of tape showing somewhat schematically the relative position of a series of reference markers and data pulses such as might be recorded thereon by the system of FIG. 1;

FIG. 4 is a form of visual read-out system in accordance

with the present invention, and employing a mechanical vibrator for steady-state presentation;

FIG. 5 is a visual readout system such as shown in FIG. 4, with the addition of manually-operable means for obtaining an indication as to pulse spacing;

FIG. 6 is an automatic version of the manually-operable data-acquisition system of FIG. 5;

FIG. 7 illustrates the recording of data in a plurality of channels by means of a corresponding number of fixed recording heads each of which is angularly displaced with respect to the remaining heads in the direction of tape movement; and

FIG. 8 illustrates a series of pulses such as might be recorded by the arrangement of FIG. 7.

The concept herein disclosed is particularly, but not exclusively, intended for use in order to provide permanent record of the position or condition of one or more movable elements that are remotely or inaccessibly located such that direct visual observation thereof is either impracticable or impossible. The invention is especially directed to the recordation of data that varies relatively slowly with respect to time, such as conditions being found, for example, in the measurement of temperatures developed in various portions of a guided missile or satellite following the launching thereof, or in the measurement of slight departures in speed of rotation of a shaft with respect to a normal or reference value. In many instances, the information so recorded (and subsequently telemetered or otherwise made available for observation and study by technical personnel) provides the only clue as to the cause of failure of the particular component under observation, and serves as a guide to the corrective measures that should be taken to avoid a recurrence of the malfunctioning in later designs.

As an illustration, let it be assumed that a shaft **10** of FIG. 1 represents the pivot element of a condition-responsive device such as temperature-recording instrument associated with some particular component of a pilotless aircraft. Information is desired as to the variations in temperature experienced by this component under actual flight conditions, such information to be recorded in permanent form for subsequent evaluation and/or analysis.

Shaft **10**, therefore, carries a rotatable wiper contact **12** forming part of a potentiometer which includes the annular resistance element **14**. This wiper contact **12** is designed to represent (in a positional sense) the indicator of a conventional dial-type thermometer intended for visual observation, the annular resistance element **14** corresponding to the calibrated thermometer dial in that any particular location of wiper **12** (such, for example, as the one illustrated in the drawing) represents one particular value of temperaature of the component being monitored. An increase in the temperature of such component will cause a rotation of shaft **10** and hence wiper **12**, this rotation being, for example, clockwise or in the direction of the arrow.

The annular resistance element **14** is not continuous, but is split or separated to form two terminal connections **16** and **18**. The former is grounded as shown, while the latter is connected to the positive terminal of a source of potential such as the battery **20**. Clockwise rotation of wiper **12** thus causes it to successively contact points on element **14** having an increasing voltage characteristic.

A second potentiometer is also illustrated in FIG. 1, this unit being identical in all respects to that formed by the elements **12** and **14** except that the shaft **22** on which the wiper **23** of such second potentiometer is mounted is driven by a motor **24**. The resistance element **26** of the second potentiometer unit has two terminals **28** and **30** corresponding to terminals **16** and **18**, respectively, of the first-mentioned potentiometer assembly, and connected to the same battery **20**.

As the wiper contact **23** rotates, the voltage picked off thereby from the resistance element **26** increases from zero at terminal **28** to a maximum at terminal **30**. At the latter point, it drops sharply to zero, whereupon another cycle is initiated. The actual gap or spacing between both terminals **16** and **18** and terminals **28** and **30** is exaggerated in the drawing for the sake of clarity of illustration. The output voltage developed between terminal **28** and wiper **23** is represented by the waveform **32**, the latter being of generally saw-tooth configuration with relatively sharp trailing edges. As will later become apparent, linearity of the rising portion of each voltage cycle is not critical as long as the two resistance elements **14** and **26** possess similar electrical characteristics.

The varying voltage **32** is applied to a generator **34** which operates to produce a series of sharp output pulses **36** during the "flyback" periods of the input wave. These pulses **36**, hereinafter termed "reference markers," are representative of the passage of the wiper **23** from terminal **30** to terminal **28**, or from a voltage maximum to zero. Expressed in terms of angular rotation of shaft **22**, the pulses or markers **36** are indicative of changes in the position of wiper arm **23** from 360 degrees to 0 degrees. Each pulse **36**, therefore, may be considered as representing the time instant at which the wiper arm **23** starts at terminal **28** to progress around the periphery of the resistance element **26**.

At some point in this journey, the wiper arm **23** will occupy a position which coincides in an angular sense with the position occupied by the wiper arm **12** carried by the shaft **10**. This position is indicated in the drawing by the broken line **38**. At the time instant when the two wiper arms **12** and **23** are in angular coincidence, the voltage picked up thereby from their respective resistance elements **14** and **26** will be equal.

These two voltages are applied to a coincidence circuit **40** which is effective to trigger a second generator **42** acting to develop a pulse **44** for each occasion in which equal voltages from the wiper arms **12** and **23** are received by the coincidence circuit **40**.

It will now be appreciated that, as the wiper arm **23** rotates, a pulse will be produced at the initiation of each sweep cycle (in other words, at terminal location **28**) and also at that point where the wiper **23** is in an angular position similar to the position occupied by wiper **12** during that particular cycle of operation. The latter pulses, however, will vary in position (or time displacement) relative to the reference pulses as the position of wiper arm **12** changes to reflect a rotation of shaft **10** in response to variations in temperature of the component being monitored.

Also shown in FIG. 1 is a magnetic recording medium, such as a sensitized tape **46**, which is unwound from a storage reel **48** onto a take-up reel **50**. The latter is carried on a shaft **52** preferably driven by the same motor **24** which rotates the potentiometer wiper arm shaft **22**, these two shafts being interconnected by a gear train (not shown) having a preset ratio, or otherwise positively synchronized so that no slippage or angular displacement can occur therebetween.

Tape **46** moves across a gap **54** in a recording head **56**, the design of this gap being more fully brought out in connection with a description of FIG. 2. The head **56** is energized in more or less conventional fashion by a coil **58**. The reference pulses or markers **36** from generator **34** are applied to coil **58** over conductor **60**, while the data pulses **44** from generator **42** are also applied to coil **58** over conductor **62**.

In presently-known recording systems, the width of the gap formed in the recording head has in most cases not been considered critical in its minimum dimension, due primarily to the nature of the information which has been recorded and also to the high speed of movement of the tape across the gap. For example, in the recordation of voltage pulses of rectangular form, the fact that each such voltage pulse creates two distinct electromagnetic impressions on the sensitized tape is of no particular consequence when conventional tape speeds in the order

of 10 to 15 inches per second are employed. However, such operation is extremely wasteful of tape surface and obviously cuts down on available recording time. FIG. 2(*a*) illustrates a conventional recording head **64** having a gap **66** of standard dimensions. This gap creates a magnetic pattern on the tape (as indicated by the arrows) such that both the impressions **68** and **70** can readily be resolved by the reproducing circuitry to result in two distinct output impulses **72** and **74** extending in different directions of polarity.

In applicant's system, however, the recording head is so designed that the gap therein is extremely narrow. Operation is then as shown in FIG. 2(*b*). An applied pulse of, say, 10 microseconds' duration produces in effect but a single electromagnetic impression **76** which is essentially normal to the tape axis. This single tape impression, when read out, results in but a single pulse **78**, since the width of the recording gap **54**, and hence the width of tape impression **76**, is so narrow that even though the latter may actually be made up of two separate distributional patterns of the sensitized particles with which the tape is coated, these distributional characteristics cannot be resolved by conventional circuit components.

With respect to the tape speed, if the width of gap **54** is chosen to be .0002 inch (representing 5,000 gap widths or lines per inch of tape surface) then the application of input pulses of 10 microseconds' duration will permit a tape movement of as little as 5 centimeters per second, if loss of definition is limited to 1 percent of the gap width. In fact, it has been found in practice that when using a gap of .001 inch, a tape speed as low as 2 millimeters per second clearly resolves the on-and-off of an applied pulse of 10 microseconds' duration.

FIG. 3 illustrates a section of tape such as would be produced by operation of the system of FIG. 1. The reference pulses or markers **36** indicate the initiation of each operational cycle, while the distance of each data pulse **44** from its associated reference marker is an indication of the angular position of the wiper arm **12** expressed as a percentage of 360 degrees.

It should be noted that the present system is in effect a ratio form of measurement. Hence, stretching or shrinking of the tape (or other recording medium) is of no significance and, furthermore, since the pulse-generating apparatus is operationally synchronized with the tape driving components, the output is completely unaffected by variations in speed of recording or playback. In other words, pulse spacing is governed by the same conditions that govern speed of tape movement through a direct mechanical interrelationship between these two factors.

Several forms of playback apparatus are herein provided for reading out the information recorded by the system of FIG. 1. For example, FIG. 4 illustrates an assembly especially designed for visually presenting the recorded pulses on an oscilloscope **80**. In order to permit minute and protracted inspection and/or analysis of a selected pulse or group of pulses, a section of the tape **46** in front of playback head **82** is periodically scanned at a frequency, such as 60 cycles per second, which is the same as the sweep frequency of the oscilloscope **80**. This scanning of the tape **46** by developing a relative oscillatory displacement between the tape and read-out head may be effected either by the combination of a movable head and stationary tape, as in FIG. 4, or by a stationary head and an oscillatable tape, as in FIG. 5.

In the former arrangement, the readout head **82** is connected to a mechanical vibrator **84** which is pivoted at **86** in order to produce an oscillatory motion of head **82** in the direction of the arrows when energized by an alternating voltage applied to terminals **88**. Tape **46** is preferably stationary or subject only to movement by hand during this operation. A pictorial representation of the pulse arrangement on the portion of tape **46** scanned by the readout head **82** appears on the screen **90** of oscilloscope **80**, the pulses being stationary as presented due to the identity between the alternating voltage applied to the vibrator input terminals **88** and the horizontal deflection or sweep voltage applied to oscilloscope **80**.

If desired, the readout head **82** of FIG. 4 (which may be similar in all respects to the recording head **56** of FIG. 1) may be maintained stationary, as illustrated in FIG. 5, while the tape **46** has an oscillatory motion imparted thereto by passing it over a pair of rollers **91** which are carried by the mechanical vibrator **84**. The tape portion **46**(*a*) between the rollers **91** then undergoes the same oscillatory motion (about the pivot point **86** in the direction of the arrows) as that of the readout head **82** in the embodiment of FIG. 4. It should be emphasized that the relative motion between the tape and read-out head is identical in both FIGS. 4 and 5, only the arrangement for producing such relative motion being modified.

FIG. 5 sets forth, in addition to the above, means for visually determining the exact displacement of a data pulse as recorded on tape **46** from its associated reference pulse or marker. It will be recalled that successive reference markers **36** are 360 degrees apart, as indicated in FIG. 3, and that the displacement or spacing therefrom of any selected data pulse **44** is indicative of the value of the information being instantaneously presented. Consequently, in order to obtain this displacement or spacing (identified as *x* in FIG. 3) expressed in specific terms, such as degrees of rotation of shaft **10** (FIG. 1) or degrees of component temperature into which such shaft rotation may be translated, a disc **92** is provided which is calibrated in the terms desired. For example, this disc **92** may be so arranged that one complete rotation thereof corresponds to the spacing between adjacent reference markers **36** on the tape **46** of FIG. 3. In such a case, disc **92** would be connected through a gear assembly **94** to some portion of the tape driving mechanism, such as the roller **96**. The gear ratio of assembly **94**, in the example being given, is so selected that the disc **92** undergoes one complete rotation of 360 degrees for each movement of the tape **46** (caused by rotation of roller **96**) sufficient to change the alignment of the gap in head **82** from one reference marker **36** to the next. In practice the tape **46** is moved (preferably manually) to a position where one selected reference marker **36** yields maximum output as observed on the screen **90** of oscilloscope **80**. The manually-adjustable index pointer **98** is then set so that it coincides with the zero scale reading on disc **92**. Tape **46** is now moved manually to a position where the data pulse **44** associated with the selected reference marker yields a maximum output (or, in other words, the tape is moved throughout the distance *x* of FIG. 3) and the number of degrees of rotation of disc **92** is shown by the index pointer **98**. For the position of wiper **12** in FIG. 1, such a reading might be in the neighborhood of 45 degrees, or, alternatively, the corresponding value on a temperature scale.

The arrangements of FIGS. 4 and 5 require that the operator manually control the movement of tape **46** from one position to another in order to obtain the information desired on the screen of oscilloscope **80**. If it is preferred to have the recorded data presented without such manual attention, the system of FIG. 6 may be utilized. The apparatus of this embodiment is in many respects similar to that of FIG. 5, except that oscilloscope **80** is omitted and the calibrated disc **92** (which is intended for visual observation) replaced by a disc **100** forming a part of an electrical circuit.

Disc **100** is designed for rotation as a function of rotation of roller **96** in the same manner as the disc **92** of FIG. 5—that is, through the gear assembly **94**. However, the manually-adjustable index pointer **98** of the latter figure is replaced by a fixed pointer **102** of an electrically-conductive nature, this pointer being connected to one terminal of a battery or other source of potential **104** the other terminal of which is grounded as shown.

Each "calibration" of disc **100** (of which there would be 360 in the illustration given) is in the form of a thin wire or conductor embedded in the insulating material of which disc **100** is composed. These wires or conductors successively contact the fixed pointer **102** as the disc **100** rotates. Each of these conductive "calibrations" of the disc **100** is electrically joined to an annular ring **106** of metal or other conductive substance which is in constant electrical engagement with a stationary pick-off terminal **108**. Consequently, as the disc **100** rotates, a pulse is produced in the lead **110** each time that one of these conductive "calibrations" of the disc makes electrical contact with pointer **102**.

Also shown in FIG. 6 is a gating circuit **112** connected to receive the output of the playback head **82**. This gating circuit, which may be of known design, is of the "on-off" type and operates to generate an "on" voltage variation in output conductor **114** each time that a reference marker **36** is supplied thereto from the playback head **82**, and an "off" voltage variation in output conductor **116** each time that a data pulse **44** is supplied thereto by movement of tape **46** past the playback head **82**.

The "on" and "off" voltage variations from gating circuit **112** are applied to an electronic counter **118** which also receives the "calibration" pulses developed in conductor **110** by rotation of disc **100**. The latter are constantly being developed during continuous movement of tape **46** past the readout head **82**, 360 of such pulses being produced during each recording cycle as represented by the spacing between successive reference markers **36**.

Gating circuit **112** supplies an "on" pulse to condition the counter **118** for operation each time that a reference marker **36** passes by the gap in head **82**. Counter **118** then passes the "calibration" pulses to an output lead **120** until such time as it receives an "off" signal over lead **116**. The latter occurs when a data pulse **44** passes by the gap in head **82**. The number of such "calibration" pulses supplied to output conductor **120** between the "on" and "off" signals from gating circuit **112** is an indication of the distance x in FIG. 3, and may be recorded or displayed in any desired manner. It should be mentioned that it is unnecessary to operate the vibrator **84** during automatic data presentation by the circuit of FIG. 6. However, since the disc assemblies **92–98** and **100–102** may be of interchangeable design for alternative use, vibrator **84** may be present at all times and energized only when required.

It is also not necessary that the data readout in the systems of FIGS. 4, 5, and 6 be presented in visual form or directly re-recorded. If preferred, known arrangements may be employed in which such data is caused to appear on a typed or punched medium. Furthermore, continuous read-out is possible by utilizing conventional stroboscopic techniques to photographically record readings on the calibrated disc **92** of FIG. 5 through exposure of constant-velocity film.

The preceding description has been directed to the use of a storage medium for recording a single item of information which is subject to variations in magnitude. However, the ratio concept of measurement on which the present invention is based makes the disclosed system particularly suitable for so-called multi-channel recording, in which the same general region of the storage medium is utilized to record a plurality of signals representing independent aspects of the operation of some unitary assembly. In such cases, it is obvious that interchannel interference should be at a minimum. Nevertheless, the limited tape area available in conventional systems, employing separate longitudinal signal tracks frequently results in an objectionable level of cross talk unless extensive precautions are observed, such as an increase in the separation distance between bands. This obviously reduces the number of channels that may be recorded on tape of given dimensions.

It has been found that when a narrow electro-magnetic impression is made on a tape by a recording head having a very narrow gap, the fact that this recorded impression is, in effect, a picture of the gap itself makes the impression capable of being read out only by a head having a gap angularly oriented in exactly the same manner as the gap of the recording head. This circumstance makes possible the recordation of a plurality of separate channels of information within the same general tape region by angularly displacing the parallel axes of the pulses in any one particular channel with respect to the respective axes of the pulses in each of the remaining channels.

FIG. 7 illustrates the above principle. The recording and/or playback head for channel #1 has a gap which may be effectively normal to the longitudinal axis of the tape, this position corresponding to that of the gap in head **56** of FIG. 1 or the gap in head **82** of FIGS. 4, 5, and 6. It therefore produces a tape impression of similar orientation, as depicted in the left-hand portion of FIG. 7. To now record information in another channel and subsequently read out this information, a second head is provided the gap of which is angularly displaced with respect to that of head No. 1. If required, still another head may be utilized the gap of which is angularly offset with respect to those of both heads #1 and 2. It should be particularly noted that the pulses of all three channels are, in effect, superimposed one upon the other, the actual crossover area of the pulses being extremely small in comparison to their total length. Thus, if a particular head has a gap disposed to read out a pulse having a specific orientation, this head will be almost completely unresponsive to the electromagnetic energy in all other pulses which are angularly offset in any direction and by greater than a minimum amount with respect to the specific pulse in question. It can be showed mathematically, and in fact has been determined by actual experimentation, that an angular separation of two degrees between adjacent channel pulses is sufficient to permit 50 percent recovery of the recorded information. The clipping level is of course chosen to eliminate as far as practicable all spurious noise and inter-pulse modulation which might interfere with the recovery process.

FIG. 8 illustrates the manner in which three separate channels of information may be simultaneously recorded on a tape by three separate heads positionally disposed in the manner of FIG. 7. The general relationship of data pulses and reference markers is identical to that of FIG. 3. It will be recognized that the dimensions and angular separation between pulses have been exaggerated in the drawing for ease of illustration, and that the number of channels which may be accommodated on a single tape is limited only by physical limitations on the narrowness of the gap that may be formed in the recording head and by the sensitivity of the associated electrical circuitry. With apparatus as herein set forth, the simultaneous recordation of approximately 100 separate channels of information may be readily accomplished.

It will now be appreciated that the disclosed system is capable of concentrating data to a degree not hitherto possible, and hence is particularly suitable for use in circumstances where prolonged periods of reproduction must be made without interruption. Conditions of this nature may be encountered, for example, aboard long-flight missiles, or in remote ground areas which must remain unattended for considerable periods of time.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claim the invention may be practiced otherwise than as specifically described.

I claim:

In a system for permitting a steady-state readout of information recorded on a storage medium, the combination of a playback head having a gap located in close proximity to a selected portion of said storage medium, a

mechanical vibrator, means for mounting said playback head on said vibrator, means for energizing said vibrator at a substantially constant amplitude and frequency so that said playback head will in effect periodically scan the selected portion of said storage medium with which it is in proximity, an oscilloscope connected to receive the output of said playback head, and means for applying a time-base deflection voltage to said oscilloscope of the same frequency as that of the energy supplied to said vibrator, so that the information derived from the said storage medium will be visually presented by said oscilloscope in a steady-state condition.

References Cited by the Examiner

UNITED STATES PATENTS

2,658,950	11/1953	Canfora	340—174.1
2,681,387	6/1954	Roys	340—174.1
2,707,212	4/1955	Hickey	340—174.1
2,714,048	7/1955	Baird	340—174.1
2,986,725	5/1961	Dirks	340—174.1

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